9.3.2 Grain Harvesting

9.3.2.1 General[1]

Harvesting of grain refers to the activities performed to obtain the cereal kernels of the plant for grain, or the entire plant for forage and/or silage uses. These activities are accomplished by machines that cut, thresh, screen, clean, bind, pick, and shell the crops in the field. Harvesting also includes loading harvested crops into trucks and transporting crops in the grain field.

Crops harvested for their cereal kernels are cut as close as possible to the inflorescence (the flowering portion containing the kernels). This portion is threshed, screened, and cleaned to separate the kernels. The grain is stored in the harvest machine while the remainder of the plant is discharged back onto the field.

Combines perform all of the above activities in 1 operation. Binder machines only cut the grain plants and tie them into bundles, or leave them in a row in the field (called a windrow). The bundles are allowed to dry for threshing later by a combine with a pickup attachment.

Corn harvesting requires the only exception to the above procedures. Corn is harvested by mechanical pickers, picker/shellers, and combines with corn head attachments. These machines cut and husk the ears from the standing stalk. The sheller unit also removes the kernels from the ear. After husking, a binder is sometimes used to bundle entire plants into piles (called shocks) to dry.

For forage and/or silage, mowers, crushers, windrowers, field choppers, binders, and similar cutting machines are used to harvest grasses, stalks, and cereal kernels. These machines cut the plants as close to the ground as possible and leave them in a windrow. The plants are later picked up and tied by a baler.

Harvested crops are loaded onto trucks in the field. Grain kernels are loaded through a spout from the combine, and forage and silage bales are manually or mechanically placed in the trucks. The harvested crop is then transported from the field to a storage facility.

9.3.2.2 Emissions And Controls[1]

Emissions are generated by 3 grain harvesting operations: (1) crop handling by the harvest machine, (2) loading of the harvested crop into trucks, and (3) transport by trucks in the field. Particulate matter, composed of soil dust and plant tissue fragments (chaff), may be entrained by wind. Particulate emissions from these operations (<7 micrometers [µm] mean aerodynamic diameter) were developed in Reference 1. For this study, collection stations with air samplers were located downwind (leeward) from the harvesting operations, and dust concentrations were measured at the visible plume centerline and at a constant distance behind the combines. For product loading, since the trailer is stationary while being loaded, it was necessary only to take measurements a fixed distance downwind from the trailer while the plume or puff passed over. The concentration measured for harvesting and loading was applied to a point source atmospheric diffusion model to calculate the source emission rate. For field transport, the air samplers were again placed a fixed distance downwind from the path of the truck, but this time the concentration measured was applied to a line source diffusion model. Readings taken upwind of all field activity gave background concentrations. Particulate emission factors for wheat and sorghum harvesting operations are shown in Table 9.3.2-1.

Table 9.3.2 (Metric And English Units). EMISSION RATES/FACTORS FROM GRAIN HARVESTING[a]

EMISSION FACTOR RATING: D

Operation	Emission Rate[b]				Emission Factor[c]			
	Wheat		Sorghum		Wheat		Sorghum	
	mg/s	lb/hr	mg/s	lb/hr	g/km^2	lb/mi^2	g/km^2	lb/mi^2
Harvest machine	3.4	0.027	23.0	0.18	170.0	0.96	1110.0	6.5
Truck loading	1.8	0.014	1.8	0.014	12.0	0.07	22.0	0.13
Field transport	47.0	0.37	47.0	0.37	110.0	0.65	200.0	1.2

[a] Reference 1.

[b] Assumptions from References 1 are an average combine speed of 3.36 meters per second, combine swath width of 6.07 meters, and a field transport speed of 4.48 meters per second.

[c] In addition to footnote b, assumptions are a truck loading time of 6 minutes, a truck capacity of 0.052 km^2 for wheat and 0.029 km^2 for sorghum, and a filled truck travel time of 125 seconds per load.

Emission rates are expressed in units of milligrams per second (mg/s) and pounds per hour (lb/hr); factors are expressed in units of grams per square kilometer (g/km^2) and pounds per square mile (lb/mi^2).

There are no control techniques specifically implemented for the reduction of air pollution emissions from grain harvesting. However, several practices and occurrences do affect emission rates and concentration. The use of terraces, contouring, and stripcropping to inhibit soil erosion will suppress the entrainment of harvested crop fragments in the wind. Shelterbelts, positioned perpendicular to the prevailing wind, will lower emissions by reducing the wind velocity across the field. By minimizing tillage and avoiding residue burning, the soil will remain consolidated and less prone to disturbance from transport activities.

Reference For Section 9.3.2

1. R. A. Wachten and T. R. Blackwood, *Source Assessment: Harvesting Of Grain—State Of The Art*, EPA-600/2-79-107f, U. S. Environmental Protection Agency, Cincinnati, OH, July 1977.